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ENERGY & DEVELOPMENT
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SESSION 7A - RENEWABLE ENERGY SOURCES:
High Penetration, Energy Storage, PPA and Grid
Management

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Carbon Free Future for Energy

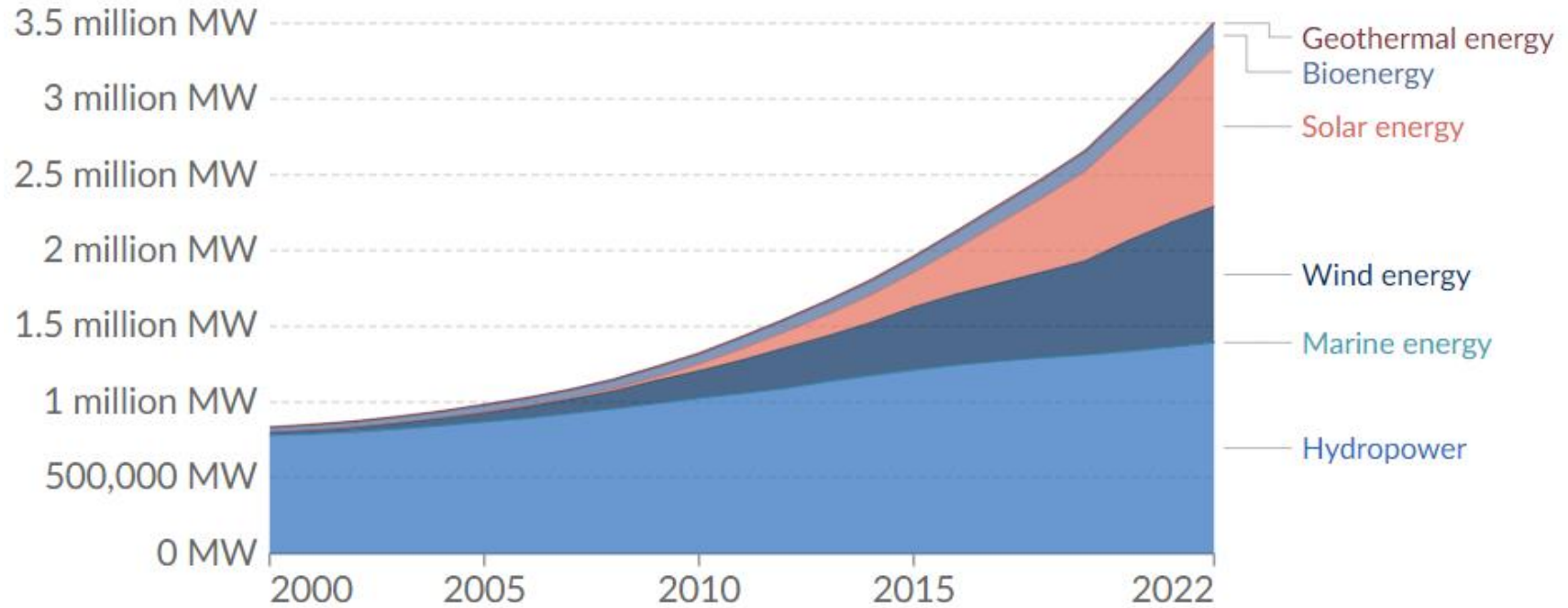


- **Electricity production: carbon free sources**
- **Renewable energy share will increase**
- **Energy storage: stability for supply, reliability for network and reduction in the cost.**

MAIN PROBLEMS IN THE SE EUROPE FOR BETTER PENETRATION OF RENEWABLES

- INFRASTRUCTURE: CONNECTIVITY
- BUREAUCRATIC FORMALITIES
- INCREASING COST OF FINANCE
- UNATTRACTIVE FEASIBILITIES DUE TO LOWER ELECTRICITY PRICES
- NOT WELL ESTABLISHED PPA STRUCTURE
- STORAGE NEEDS AFTER SOME MATURITY LEVELS

INCREASING IMPORTANCE OF SOLAR & WIND

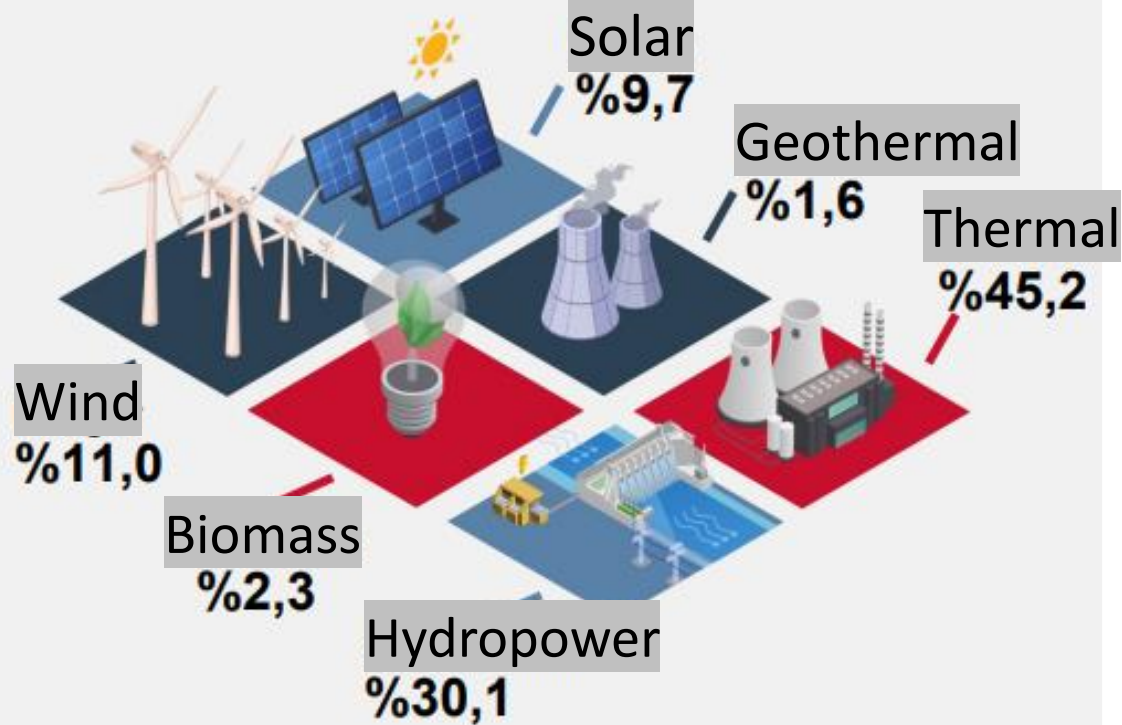


Source: International Renewable Energy Agency (IRENA)

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INSTALLED POWER IN TURKEY (June 2023)

Installed Power: 107 GW in November 2023.



Main Problems for more Renewable Penetration in Turkey

- Lack of Finance
- Cost of Finance
- Low (subsidized) electricity prices
- Bureaucratic formalities (construction permit, licensing procedures, etc.)

Positive Issues for better penetration of RE in Turkey

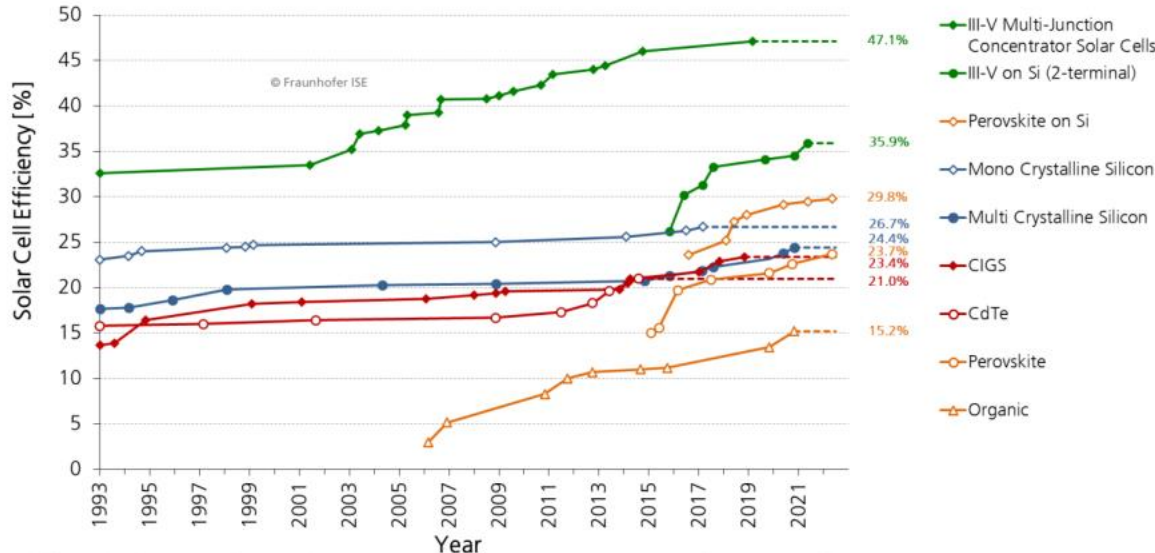
- Local production of Technologies/products
- High Connectivity Capacity: 75 GW licences were distributed.
- Good infrastructure for connection
- Regulations, supporting schemes
- Energetic investors; risk appetite
- Supporting Technologies (like fast EV

New RE Licence Capacities in Turkey (Distributed)

- **Storage + RE: 30 GW**
- **Own Consumption: 25 GW**
- **Hybride: 10 GW**
- **RENEWABLE ENERGY RESOURCE AREAS
(YEKA): 10 GW.**

Increasing efficiencies, bigger market size

Development of Laboratory Solar Cell Efficiencies



Data: Solar Cell Efficiency Tables (Versions 1 to 60), Progress in Photovoltaics: Research and Applications, 1993-2022. Graph: Fraunhofer ISE 2022. Date of data: May 2022

***The record lab cell efficiency 2022**

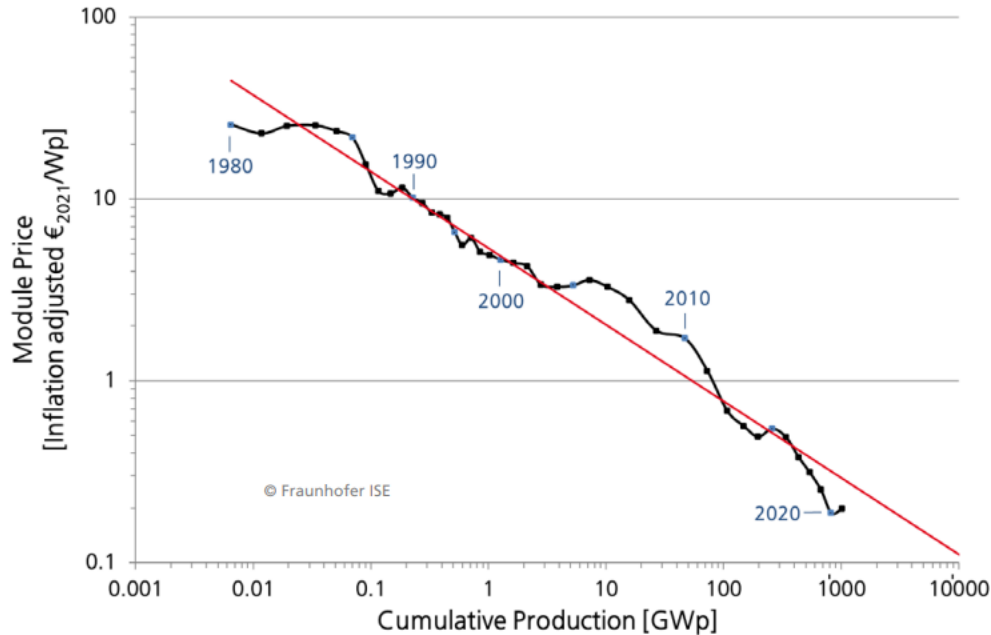
Silicon wafer-based technology

- Mono-crystalline silicon : 26.7%
- Multi-crystalline silicon : 24.4%

Thin film technology

- CIGS solar cells: 23.4%
- CdTe solar cells : 21.0%
- Perovskite solar cells: 23.7%.

Results in lowering costs



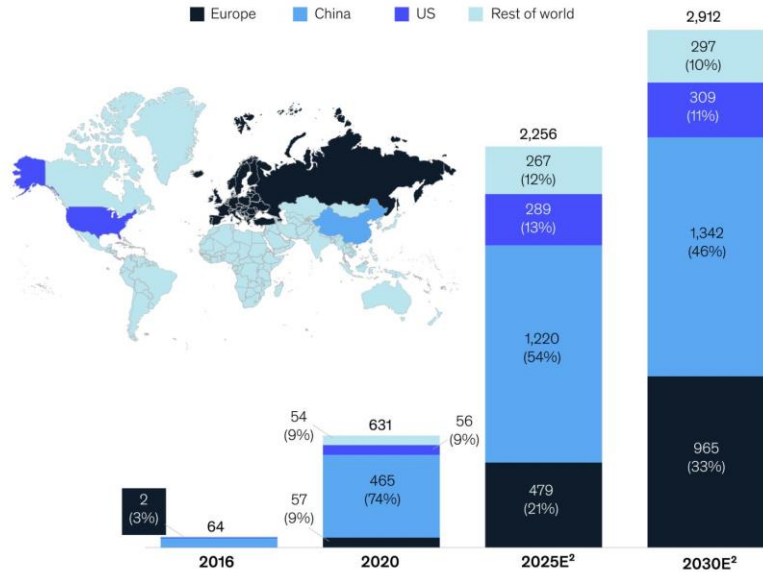
- Current panel price: 0.12-0.13 Euro/Watt!!!

Data: from 1980 to 2010 estimation from different sources: Strategies Unlimited, Navigant Consulting, EUPD, pvXchange; from 2011: IHS Markit; Graph: PSE 2022

Storage Capacities

Battery production capacity is surging around the world.

Battery cell production capacity, GWh annually¹

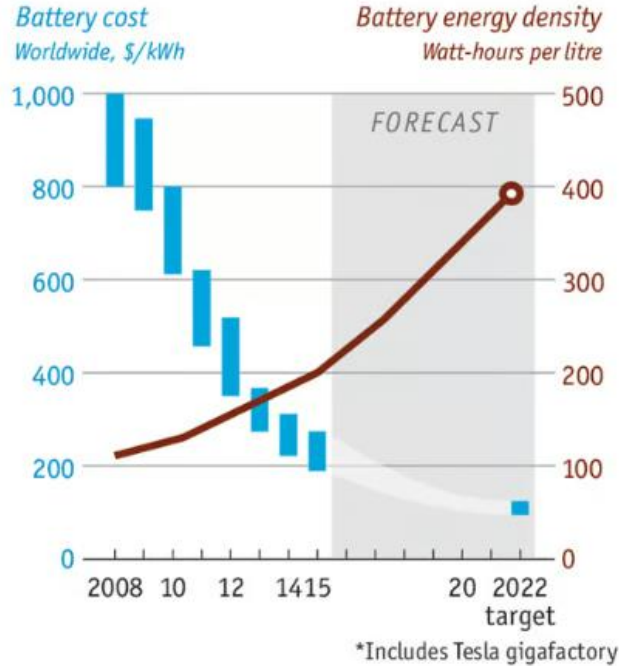


¹Figures may not sum, because of rounding.
²Estimated based on announcements of battery cell manufacturers.
Source: McKinsey battery supply tracker (June 2021)

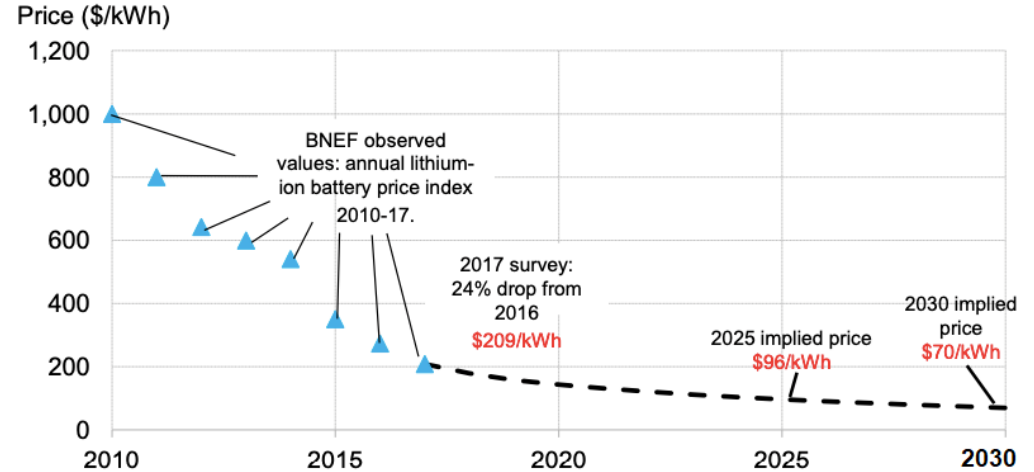
- 10 biggest from Asia
- China 56%
- S.Korea: 26%
- Japan: 10%
- 92% of production is coming from 3 countries
- 3 companies: 70% market share.

Storage

Efficiency increase, decrease in the cost



Lithium-ion battery pack price forecast

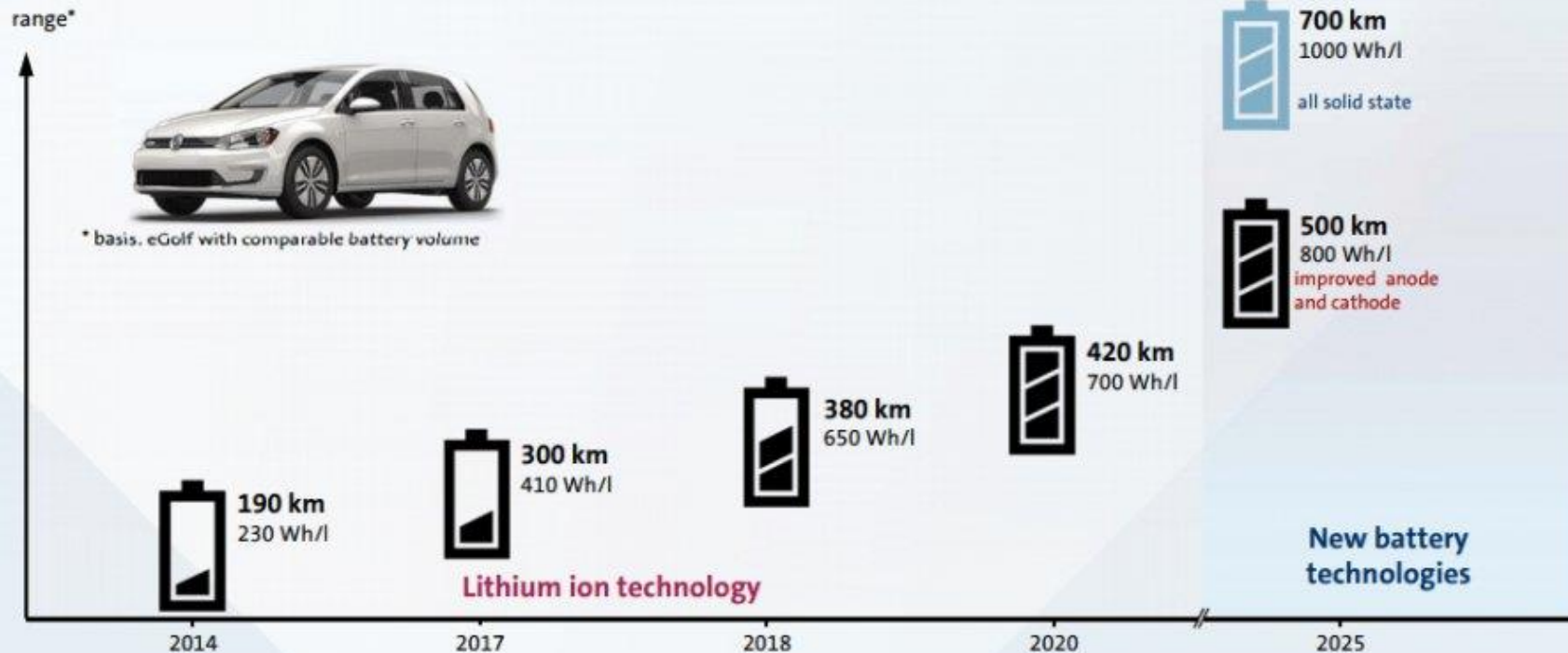


Source: Bloomberg NEF

<https://www.economist.com/graphic-detail/2017/08/14/the-growth-of-lithium-ion-battery-power>

<https://www.frontiersin.org/research-topics/10251/long-duration-and-long-term-energy-storage-for-renewable-integration>

Advances in battery technology will improve range, weight and costs



5 JULY 2022, LAW FOR STORAGE

- 1- If you install a solar or wind capacity, you can get the same amount of RE licence.
- 2- If you have already installed solar or wind plant, if you install the same amount of storage, your licence will be doubled.



Regulation for Storage

Min. : 20 MW

20MW : 20 MWh

Wind:
20MW min.
250 MW max.



Min. : 10 MW

10MW : 10 MWh

Solar:
10MW min.
250 MW max.



Storage + RE Applications

1. Total capacity: 30 GW
2. Applications : 280 GW
3. Wind : 55%
4. Solar: 45%
5. Pre-licenced: 27GW
6. Under evaluation: 13GW



New trends: EV

- **EV Charging Stations in Turkey**



- **141 company got licence for EV charging stations**
- **Commercial 9000 stations are serving (as of Nov.2023)**
- **25% are DC, others AC.**
- **Turkey is one of the leading countries in Europe.**

CONCLUSIONS



THANK YOU

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